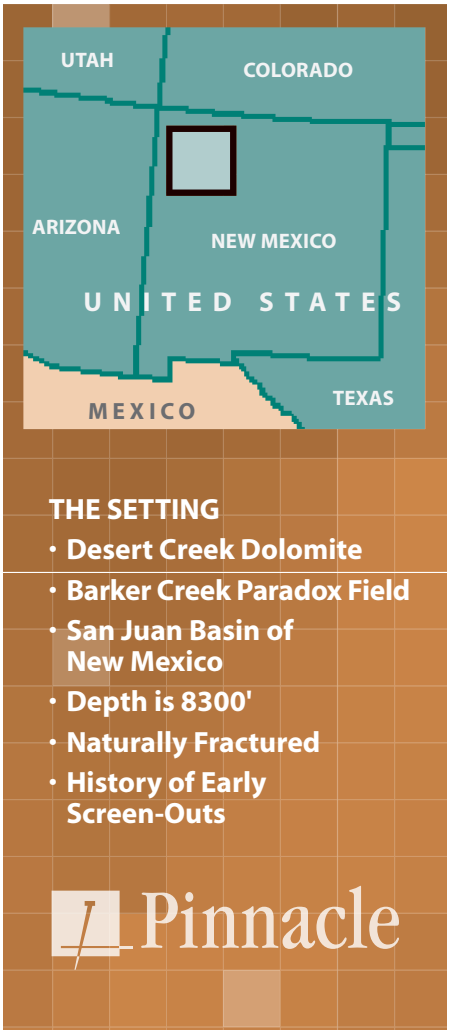
Up the Creek Without a Frac



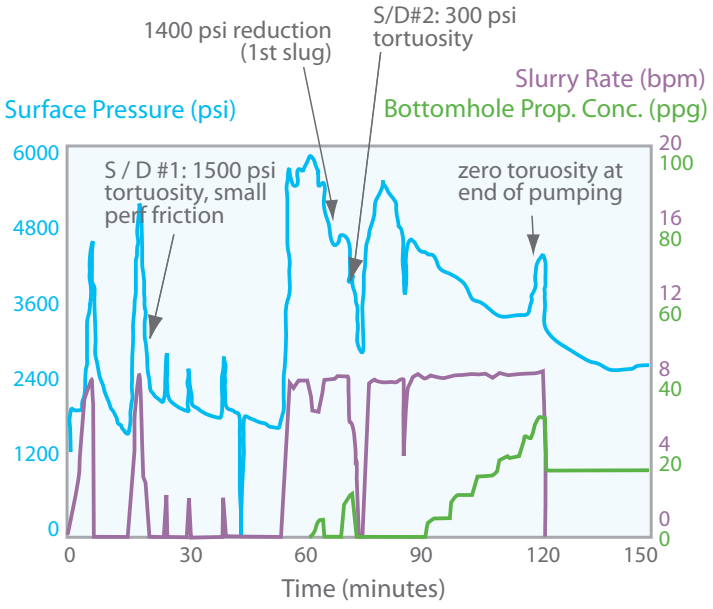
THE BACKGROUND

Burlington Resources is developing the Desert Creek Dolomite in the Barker Creek Paradox Field of the San Juan Basin. Historically, this reservoir has suffered from marginal economic performance when completed naturally, but most wells have been produced without propped fractures due to difficulties with early screen-outs while placing fracture treatments. Prior to this treatment, a directly offsetting well with a similar completion history also experienced a "pressure-out" on pad, making placement of a propped treatment impossible. This propped fracture treatment was performed due to disappointing productivity following an acid treatment. As shown by the figure, this well also showed declining injectivity leading to "pressure-out" on pad as the treatment is reaching the maximum surface pressure of 6000 psi. Without a propped fracture in place, economics for this well would be very marginal.

PINNACLE PERFORMS

Pinnacle Technologies used real-time fracture pressure analysis to diagnose the root cause of the problem on location in real-time and take corrective actions to make the job successful. We conducted rate stepdown tests to identify the source of near-wellbore friction (tortuosity or perforation friction) and to measure the impact of proppant slugs. Prior to the propped fracture treatment, a rate step-down test was performed using surface pressure data, which showed that near-wellbore fracture tortuosity was an extremely high 1500 psi at 40 bpm. This was most likely caused by the simultaneous propagation of near-wellbore multiple hydraulic fractures, due to the long perforated interval (70 ft @ 4 SPF) and a pre-frac acid job (20,000 gal) that may have provided multiple fracture initiation points from complex acid-etched near-wellbore fractures.

To plug off some of these near-wellbore multiple fractures, Pinnacle recommended pumping proppant slugs until tortuosity



Treatment History Plot showing severe near wellbore friction (fracture tortuosity) that was solved by pumping two proppant slugs early during the pad stage.

Desert Creek Formation	time (min)	total friction (psi)	near-wellbore friction (psi)
Shut-in after 1st injection	7	1650	1000
Stepdown after 2nd injection	20	2360	1690
Start of Pad	63	3280	2200
Between proppant slugs	68	1880	800
Stepdown after 2nd slug	76	1630	500
End of pumping	122	1150	0

Total Friction and near-wellbore friction during the fracture treatment in the Desert Creek Dolomite at flow rate of 40 bpm.

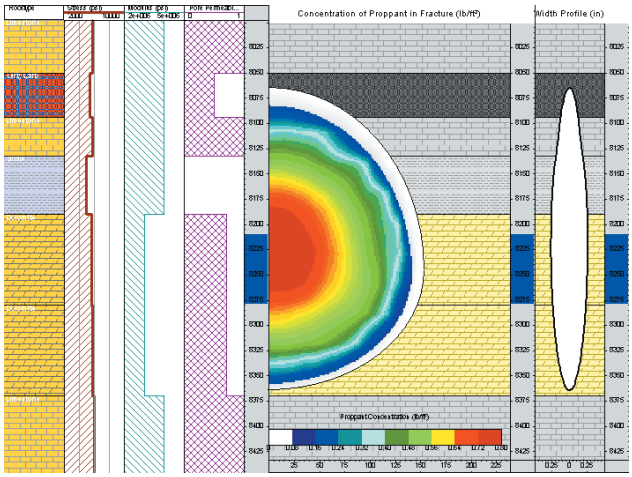
was reduced to an acceptable level. Two slugs (50 bbl @ 1 and 2 ppg) were pumped very early during the pad stage. The proppant slugs dramatically reduced the tortuosity to an acceptable 300 psi as is shown for rate-stepdown test #2.

THE RESULTS

Significant reduction in near-wellbore friction due to proppant slugs allowed successful placement of all 150,000 lbs of proppant as designed, and also allowed a real-time decision on-site to increase maximum proppant loading from 4 PPG to 6 PPG, improving fracture conductivity for this moderate-permeability well.

The initial post-frac production response was more than 3 MMscfd; about three times the pre-frac rate. Since earlier experiences suggested that this formation could not be propped fracture treated at all, Pinnacle's real-data fracture diagnostics yielded an increase in NPV of $1.6 million (based on $1/Mscf) over three years of production. Additionally, fracture treatment costs have been significantly reduced due to reducing the number of attempts required to place a successful treatment.

FracproPT



Main propped geometry for propped fracture treatment—best net pressure match used equivalent of four fractures simultaneously propagating.

Houston 281–876–2323
Denver 720–344–3464
Calgary 403–516–2260
Bakersfield 661–335–7711
San Francisco 415–861–1097
Dallas 972–401–0090
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Midland 432–386–6791
Reynosa 52–892–42191
Cairo 2025283356–8

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